THE NATURALIST.

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[Since the publication of the first number of this work, several of our patrons have urged the necessity of a Glossary, or explanation of some of the elementary terms employed in Natural History, for the benefit of those who have not made much advancement in the science. Our object at the commencement of this work was, to use as few technical words as possible; and such as we could not avoid, to explain at their places; but we will present the following sketch, which will give a general view of the subject.]

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THE science of Natural History comprehends a description of every material substance, organized and inorganized, animate and inanimate, that exists naturally within and upon this globe, including the atmosphere. In other words, it embraces every earthly, material object that is not artificial. Those who with a philosophic eye have contemplated the productions of Nature, have all, by common consent, divided them into three branches, viz: *Zoology, Botany* and *Mineralogy.*

I. ZOOLOGY.

Zoology is the science which treats of material, organized beings, which are endowed with the sentient or perceiviug principle. In short, it includes every earthly being that *grows, lives* and *feels.*

We find it somewhat difficult to draw a line of distinction between the different kinds of organized beings, that is, animals and vegetables; the lines of distinction often seem to fade so gradually, that we cannot well decide where the animal ends and the vegetable begins. It is generally true that animals differ from vegetables in possessing locomotive, as

well as sentient powers. This is a good distinction between the *ox* and the *oak;* but is very deficient when applied to the *isis* and the *sensitive plants.*

Animals receive their food into internal cavities, which are so modified as to furnish the fluids which supply the wants of the system. And probably no substance is received as the food of animals, which has not previously been in an organized state. Whereas vegetables receive inorganic matter for food, as well as that which has been organized; and their food is chiefly received through tubular radicles, or pores of leaves, which have the power to direct their courses or pores towards water, air, light and heat.

All animals have the sense of feeling. But they have no particular organ for that sensation; it is depending on *papillæ,* or small protuberances at the ends of the nerves, which terminate in every part of the skin. All vertebral animals have four organs of sense. Each organ is adapted to its particular office. One for communicating the sensation of sight, one for sound, one for taste, and one for smell. Some of the other divisions of animals have more or less of these organs in greater or less perfection.

All animals seem to require a system of organs for digesting food, for circulating fluids through the body, and for oxydating those fluids. In vertebral animals these organs consist of stomachs, to which an alimentary canal is attached; a heart which is alternately contracted and expanded, to which a set of arteries and veins are attached—the former for conveying the fluids from the heart, and the latter for returning them to the heart; lungs or gills in which the same fluids are presented to the oxygen of the atmosphere. Some animals have their fluids oxydated by means of spiracles or breathing holes, some by means of exterior membranous organs.

Grand Divisions. The subjects of Zoology are distributed into four grand divisions; because animals appear to have been organized upon four general plans.

I. *Vertebral Animals.*—In this division the sentient principle is lodged in a medullary substance, the basis of which is inclosed in a bony tube, composed of a column of vertebræ.

To the nervous axis inclosed in a bony tube, which is called the *medulla spinalis,* there is an appendage at one extremity denominated the *brain.* This is inclosed in a bony case, called the *cranium* or skull. But animals of this division have another system of nerves, more analagous to the systems found in the other three divisions than the medulla spinalis. It is that system which extends through the heart, lungs and

stomach, and is connected with the brain by a very minute fibre. Nature seems to have been very solicitous to provide for the digestive, respiratory and circulatory systems, in every division of animals. The system of nerves, devoted to this object, is kept almost distinct in vertebral animals, and the medulla spinalis, as well as the brain, seem to be but appendages.

The organs of sense and motion are all double, and are arranged on two sides of the nervous axis. To the vertebral column are attached two series of ribs, constituting the chief frame-work of the body. Strong bony limbs are bound to each extremity of the bony column, which are mostly covered by the muscles which give them motion. The viscera that are the most essential to life, are inclosed in the head and spine.

Both brain and medulla spinalis being peculiar to this division, the sentient principle is much more perfect in this than in the other divisions. Here we find four pair of organs of sense. Two eyes, two ears, two nostrils, and two fleshy masses constituting a tongue, or rather a pair of organs of taste.

These animals have red blood, hearts with alternate motions of contraction and dilatation, horizontal jaws adapted to the preparation of food for the digestive process. They are viviparous or oviparous, and from the commencement of their lives till death, they supply the daily waste of their bodies by masticating and passing into the stomach, aliment suited to their respective natures. A part of this aliment is carried into the circulatory system by lymphatic vessels.

Animals of this division being more complicated in their structure, are subject to a greater variety of diseases. They have more acute pains and more exquisite pleasures.

Examples. Man, bat, squirrel, elephant, deer, whale, eagle, humming-bird, tortoise, crocodile, viper, frog, eel, shark, salmon.

II. *Articulated Animals.*—In this division the sentient principle is lodged in two long cords, swelling at intervals into knots or ganglions, extended through a jointed body in the longitudinal direction. The organs of sense and motion are all double, and arranged on two sides of the nervous axis.

The principle ganglion is placed near the throat. They have jointed trunks or abdomens; and all but one class, have jointed limbs articulated to an external crust or to a rigid covering. They draw in their food through suckers or tubes, serving as mouths, in most cases. Air vessels, through which respiration is performed, open on the sides of their bodies or limbs.

They have two eyes, which may be of two kinds. The simple kind appears like a small lens. The compound kind has its surface divided into an infinite number of lenses; each answering to a fibre of the optic nerves. Excepting the classes of jointed worms and of spiders, all articulated animals have *antennæ*, or jointed, filiform, flexible horns. With these they seem to effect many purposes; such as examining bodies within their reach, determining the state of the atmosphere, and to derive sensations of which we have no knowledge.

They have the sense of smell and of hearing; but it is not known in what organs these senses are placed. Some have jaws of a curious character. Often a pair of strong pincers for grasping and breaking up their food, and for defence. These are called mandibles. Two pair within these are called levers and lips. To the levers or jaws are attached jointed filaments, called *palpi* or feelers, which are supposed to serve the animal for examining its food. The tongue commonly adheres to the lower lever. In some the fore feet serve in place of some of these appendages; in others the jaws are increased in number. Some have a *proboscis* or tube through which food is imbibed.

They are mostly produced from eggs. Some become perfect immediately from the egg; but more are changed from the egg to the *larva*, called caterpillar, worm, maggot or skipper, from larva to *pupa*, called aurelia, nymph or chrysalis, from pupa to the *imago*, or perfect insect. They are generally the most voracious while in the larva state. Some live long in the larva state, and but a short time in the state of the perfect insect. As the *cicadia septendecim*, American locust, remains in the larva state seventeen years, and in the state of perfect insect but about a week, and eats nothing during that period. Others are in the larva state but a short time in proportion to their duration in the insect state; as *musca domestica*, the common house-fly, which continues a long time and eats continually.

Animals of this division were probably created before the vertebral. For it is said that the cast-off crusts of the chrysalis of some species are found in older rocks than the bones of vertebral animals. Productions of this kind are rarely found. Perhaps fishes are found in formations about as old as any of this division.

Examples. Angle-worm, leach, lobster, spider, beetle, cricket, bee, butterfly, gnat.

III. *Molluscous Animals.*—In this division the sentient principle is lodged in a number of medullary masses, dispers-

ed in different parts of a soft body. And though the medullary masses are not always united by nervous filaments, the organs of sense and motion are arranged more or less on two sides of a nervous axis or longitudinal series of medullary masses.

The principal medullary mass is situated upon the throat. The circulatory system is considerably complicated; much more so than that of the articulated division. The blood is dark colored or blue. The fibrous part of their muscles appear more abundant than in vertebral animals. Their muscles are attached to many parts of the skin, forming a tissure more or less complicated and compact. By various contractions and elongations they move, swim, and perform other motions. They have considerable irritability; the naked skin is very sensible and furnished with a liquid humor which issues from its pores.

Molluscous animals are generally covered with plates of carbonate of lime, which serve as beds or retreats from danger. These plates, usually called shells, are produced by secretion from the skin. The process of reproduction greatly resembles that of plants with perfect flowers.

Animals of this division, though more complicated in their digestive and circulatory system, than animals of the articulated division, seem to have been contemporaries with the oldest of the radiated division. For we find the remains of several species of this division in the oldest transition rocks, which rarely if ever, contain any relics of the articulated or vertebral divisions.

Examples. Nautilus, snails, oysters, barnacles.

IV. *Radiated Animals, or Zoophytes.*—In this division the sentient principle is lodged in, or in some unknown manner, attached to a medullary globule, spheroid or ring, with radiating branches.

Animals of this class are but little more complicated in their structure than plants. No distinct system of nerves nor any organs of sense have been discovered. Feint vestiges of circulation are with difficulty perceived. Their respiratory organs are mostly on the surface of the body. Some receive their food through a mouth, others through pores.

Some animals of this division may be cut across, and both parts will live. This is explained by supposing the animal to consist of a column or pile of distinct animals, and that the tranverse cutting produces a mere separation of a column of individuals into several shorter columns.

The process of reproduction among this division of animals resembles that of plants with perfect flowers. Some of

them may be propagated by cuttings like plants. In this, and in some other particulars, they seem to partake of the nature of plants and animals; and are therefore called ***zoophytes***, or animal plants. They are the most simple in their organization, and seem to have been some of the earliest inhabitants of the earth; as some of the species are found in the oldest rocks, which contain any petrifactions.

Examples. Sea-hedgehog, starfish, sea-nettle, corals, corallines, animalculæ, tape-worm.

Many of the zoophytes, as the *corals*, are fixed to rocks and are incapable of moving; others, as the *sea-anemone*, grow upon rocks, having a kind of stem, like a flower; some are attached by a kind of root to the bottom of the sea; others are carried about by the action of the waters, without any voluntary motion. We find here the *sea-pen*, the *sea-fan*, and the *madrepore*, the latter of which are often thrown together in such quantities, as to form islands of coral, and to block up the entrance of harbors. The sponge also belongs to this class of strange animal substances; this consists of a fibrous mass, which, when fresh, contains a kind of substance like jelly, which manifests a slight sensation when touched; its surface is full of small mouths, with which it absorbs and rejects water.

Animals are likewise divided into two general departments, viz: Vertebral, those having backbones; and Invertebral, those that are destitute of them.

Vertebral animals are divided into—1. *Quadrupeds*, the science of which has no popular name. It includes four-footed animals; as ox, dog, mouse. 2. *Birds*, the science of which is called *Ornithology*. It includes the feathered tribe; as pigeon, duck, wren. 3. *Amphibious animals*, the science of which is called *Amphibiology*. It includes those cold-blooded animals, which are capable of living on dry land, or in the water; as tortoise, lizard, serpent, frog. 4. *Fishes*, the science of which is called *Ichthyology*. It includes all aquatic animals which have gills and fins; as shad, trout, sturgeon.

Invertebral animals are divided into—5. *Insects*, the science of which is called *Entomology*. It includes all animals with jointed bodies, which have jointed limbs; as flies, spiders, lobsters. 6. *Vermes*, the science of which is called *Helminthology*. It includes all soft animals of the invertebral division, which have no jointed limbs, with or without hard coverings; as angle worms, snails, oysters, polypi, infusory animals. The science which treats of shell-fish, or shells, is called *Conchology*.

Animals are also distributed into groups, for the convenience of ascertaining their names and of studying their affinities. These groups or assemblages are called Classes, Orders, Genera, Species and Varieties.

An *Individual* is an organized being complete in its parts, distinct and separate from all other beings.

When a new individual springs up and is propagated by generation, this constitutes a *Variety*, in the language of naturalists. The number and degree of these variations are confined within narrow limits; they occur chiefly in the domesticated animals, and have not interfered with the transmission and continuation of those forms which constitute species.

A *Species* is a collection of all the individuals which have descended one from the other, or from common parents, and of all those which resemble them as much as they resemble each other, and are known from one another by their size, color, form, and various other circumstances of external appearances.

When several species agree in leading points of organization, and likewise in general habits and character, they are called a *Genus*. For example, the lion, tiger, lynx, leopard, panther, cat species, and others, compose the genus *felis*, or cat. All these have a savage character, as they prey on living animals. For this purpose they are armed with powerful teeth, with great muscular strength in the jaws, neck and limbs; their tongues are covered with sharp, horny prickles; and they are furnished with curved, sharp and cutting nails, or claws, which, by a peculiar mechanism, are retracted so as not to press against the ground when they are not using them.

The genera are formed into groups called *Orders;* thus the ox, sheep, goat, deer, antelope, camel, llama, and other genera, compose the order *ruminantia.* All these feed on vegetables, and submit their food to a double process of mastication, in reference to which the stomach possesses a very peculiar and complicated structure. This vegetable diet, and this process of rumination, are connected with certain structures of teeth and jaws, with peculiar arrangements of the organs of sensation and motion, and with certain general habits, which produce great similarity of character throughout the whole order.

The different orders are again arranged into certain *Classes;* thus all the animals that are viviparous, and in which the young are nourished for a certain time by milk, are united into the class *mammalia,* or mammiferous animals; so

called from their *mammæ*, or glandular organs, which secrete the fluid nutriment of the young.

Lastly, the classes are assembled, on the same principle of resemblance, into *Grand Divisions* of the animal kingdom; thus mammalia, birds, fishes and reptiles constitute the grand division *vertebralia*, or vertebral animals, all of which possess a vertebral column, or backbone—the most important piece of an internal articulated skeleton.

A scheme of the animal kingdom drawn out on these principles, is called a *natural method* of distribution; because the natural relations or resemblances of the objects comprised in it are the basis of its formation. To complete it, an accurate knowledge of the whole animated creation is necessary; so that it cannot be attempted with any reasonable chance of success, except in an advanced state of the science.

When such an arrangement is properly executed, that is, when the animals are assigned to each division according to their resemblances of structure, so that the species of each genus are alike, and more like to each other than to those of any other genus; and when the same remark is true concerning the genera of each order, the orders of each class, and the classes of each department, it is an abridged expression of the whole science, the imbodied result of all our knowledge concerning the structure and habits of animals. The place which any animal occupies denotes all the leading circumstances of its organization and economy, and expresses them in a few words. We say, for example, that the dromedary belongs to the genus *camelus*, order *ruminantia*, class *mammalia*, and department *vertebralia*. To a person conversant with the principles of the arrangement, these four words convey a general notion of the animal, which would otherwise require a lengthened description.

The great utility of this scientific short-hand writing, in abbreviating descriptions, is too obvious to need illustration; it is absolutely indispensable when we come to delineate the structure and modifications of organs throughout the whole animal kingdom.

We shall make no further use of this method in this work, than will be required to explain the subjects treated of. Those who wish to pursue the subject further, we would refer to the recent work of Cuvier, entitled, '*The Animal Kingdom distributed according to its Organization*,' which contains the most complete and accurate view of the subject.

(*Botany and Mineralogy are deferred.*)

MAN.

Grand Division—*Vertebralia*, possessing a vertebral column or spine. Class—*Mammalia*, nourishing the young by milk. Order—*Bimanum*, having two hands. Genus—*Homo*, comprising man. Species—*Sapiens*, endowed with wisdom.

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II. Mongolian Variety. (See Fig. 1.) *Characters.*—An olive-colored skin, which in many cases is very light, and black eyes; black, straight, strong and thin hair; little or no beard; head of a square form, with small and low forehead; broad and flattened face, with the features running together; nose small and flat; rounded cheeks projecting externally; narrow and linear aperture of the eyelids; eyes placed very obliquely; slight projection of the chin; large ears; thick lips. The stature, particularly in the country near the North Pole, is inferior to that of Europeans.

It includes the numerous more or less rude, and in great part Nomadic tribes, which occupy central and northern Asia; as the Mongols, Calmucks, and Burats; the Mantchos or Mandshurs, Daourians, Tungooses and Coreans; the Samoiedes, Yukagirs, Coriacks, Tschutski, and Kamtschadales; the Chinese and Japanese; the inhabitants of Thibet and Bootan; those of Tonquin, Cochin-China, Ava, Pegu, Cambodia, Laos, and Siam; the Finnish races of northern Europe, as the Laplanders; and the tribes of Eskimaux, extending over the northern parts of America, from Bhering's Strait to the extremity of Greenland.

The Calmucks, and all the Mongolian tribes, says Pallas, are characterized by obliquity of the eyes, which are depressed towards the nose, and by the rounded internal angle of the eyelids; by thin, black, and scarcely curved eyebrows; by the nose, which is altogether small and flat, being particularly broad towards the forehead; by high cheek bones; a round head and face. Black brown irides, large and thick lips, short chin, white teeth remaining firm and sound even in advanced age, and large ears standing off from the head, are universal. They are of middling size, and we see very tall people amongst them; the women are particularly small, and very delicately formed.

Mr. Barrow says, that the Mantchoo Tartars are scarcely distinguishable from the Chinese by external appearances: the

Chinese are rather taller, and of a more slender and delicate frame than the Tartars, who are in general short, thick and robust. The small eye, elliptical at the end next the nose, is a predominating feature in the cast of both the Chinese and Tartar countenance, and they have the same high cheek bones and pointed chins. The native color both of Chinese and Tartars seems to be that tint between a fair and dark complexion which we distinguish by the word brunet or brunette; and shades of this complexion are deeper or lighter, according as they have been more or less exposed to the influence of climate. The women of the lower class, who labor in the fields, or who dwell in vessels, are almost invariably coarse, ill-featured, and of a deep brown complexion, like that of the Hottentots. There are some women in China, though very few, who might pass for beauties even in Europe. A small black or dark brown eye, a short rounded nose, generally a little flattened, lips considerably thicker than in Europeans, and black hair, are universal.

Mr. Turner informs us, that the people of Thibet have invariably black hair, small black eyes with long pointed corners, as if extended by artificial means, eye-lashes so thin as to be scarcely perceptible, and eyebrows but slightly shaded. Below the eyes is the broadest part of the face, which is rather flat, and narrows from the cheek bones to the chin. Their skins are remarkably smooth; and most of them arrive at a very advanced age before they can boast even the earliest rudiments of a beard. Their complexion is not so dark by many shades as that of the European Portuguese.

The Eskimaux are formed on the Mongolian model, although they inhabit countries so different from the abodes of the original tribes of central Asia.

The male Eskimaux have rather a prepossessing physiognomy, but with very high cheek bones, broad foreheads, and small eyes, rather further apart than those of an European. The corners of their eyelids are drawn together so close, that none of the white is to be seen; their mouths are wide, and their teeth white and regular. The complexion is a dusky yellow, but some of the young women have a little color bursting through this dark tint. The noses of the men are rather flattened, but those of the women are rather prominent. The males are, generally speaking, between five feet five inches and five feet eight inches high, bony and broad shouldered, but do not appear to possess much muscular strength. The flesh of all the Eskimaux feels soft and flabby, which may be attributed to the nature of their food. But the most surprising

peculiarity of this people is the smallness of their hands and feet.

The same characters belong to the several tribes of Eskimaux, which are scattered over the whole breadth of the American continent. Humboldt mentions the affinity of the languages at the two extreme points; and Dr. Clark has noticed the complete resemblance of the dresses, ornaments, weapons, &c. brought by Mr. Chappell from Hudson's Straits, to those in a collection made by Commodore Billings in the north-west extremity of the continent.

Similar descriptions might be given of the other people included under this variety.

(To be continued.)

THE HIVE BEE.

Grand Division—*Articulata*, having jointed trunks and limbs. Class—*Insecta*, comprising insects. Order—*Hymenoptera*, having membranous wings. Genus—*Apis*, comprising bees. Species—*Mellifica*, productive of honey.

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Of the Nurse-Bees and Wax-Workers. Huber, by minute research, ascertained that the workers, which had been considered by former naturalists to be all alike, consist of two important classes, nurse-bees and wax-workers.

The nurse-bees are rather smaller than the wax-workers, and even when gorged with honey, their abdomens do not, as in the others, appear distended. Their business is to collect honey, and impart it to their companions; to feed and take care of the young larvæ, and to complete the combs and cells which have been founded by the others; but they are not charged with provisioning the hive.

The wax-workers on the other hand are not only a little larger, but their stomachs when gorged with honey, are capable of considerable distension, as M. Huber proved by repeated experiments. He also ascertained that neither of the species can alone fulfil all the functions shared among the workers of a hive. He painted those of each class with different colors, in order to study their proceedings, and their labors were not

interchanged. In another experiment, after supplying a hive deprived of a queen, with brood and pollen, he saw the nurse-bees quickly occupied in the nutrition of the larvæ, while those of the wax-working class neglected them. When the hive is full of combs, the wax-workers disgorge their honey into the ordinary magazines, making no wax; but if they want a reservoir for their reception, and if their queen does not find cells ready made wherein to lay her eggs, they retain the honey in their stomachs, and in twenty-four hours they produce wax. Then the labor of constructing the combs begins.

It might perhaps be supposed that, when the country does not afford honey, the wax-workers consume the provision stored up in the hive. But they are not permitted to touch it. A portion of honey is carefully preserved, and the cells containing it are protected by a waxen covering, which is never removed except in case of extreme necessity, and when honey is not to be otherwise procured. The cells are at no time opened during summer; other reservoirs, always exposed, contribute to the daily use of the community; each bee, however, supplying itself from them with nothing but what is required for present wants. Wax-workers appear with large abdomens at the entrance of their hive, only when the country affords a copious collection of honey. From this it may be concluded, that the production of the waxy matter depends on a concurrence of circumstances not invariably subsisting. Nurse-bees also produce wax, but in a very inferior quantity to what is elaborated by the real wax-workers. Another characteristic whereby an attentive observer can determine the moment of bees collecting sufficient honey to produce wax, is the strong odor of both these substances from the hive, which is not equally intense at any other time. From such data, it was easy for M. Huber to discover whether the bees worked in wax in his own hives, and in those of the other cultivators of the district.

There is still another sort of bees, first observed by Huber in 1809, which appear to be only casual inmates of the hive, and which are driven forth to starve, or are killed in conflict. They closely resemble the ordinary workers, but are less hairy, and of a much darker color. These have been called *black bees*, and are supposed by Huber to be defective bees; but Kirby and Spence conjecture that they are toil-worn, superannuated workers, of no further use, and are therefore sacrificed, because burdensome to a community which tolerates no unnecessary inmates. The very great numbers of black bees, however, which sometimes appear, does not well accord with such

an opinion. The subject remains, therefore, still in uncertainty.

Of the Wax. It is a fact established by satisfactory experiments, that whatever may be its issue from the body of the bee, wax originates from honey, elaborated into form by a process which it undergoes in the stomachs of the bees; the particular operation is a secret concealed from our research. The fact was narrowly investigated by a naturalist, observing that bees continued carrying quantities of the yellow pellets, or pollen into hives which were quite full of combs, and where there was no room to construct more; and on the other hand that they enlarged the combs of hives containing only a small portion, and did so without carrying in the pellets at all. In ascertaining the mode by which wax was produced from honey, Huber confined a swarm of bees in a straw hive to an apartment, along with a quantity of honey and water necessary for their subsistence. The honey was exhausted in five days, and five combs of the finest snow-white wax were then found suspended from the arch of the hive. Lest this might have been the produce of the farina carried in by the bees when their confinement commenced, all the combs were removed, and the imprisonment of the bees repeated. But the result was the same, they formed other five combs of the finest and whitest wax. Mr. Wistar, of Germantown, mentions two facts equally conclusive on this subject.

I had, says he, a late swarm last summer, which in consequence of the drought filled only one box with honey. As it was late in the season, and the food collected would not enable the bees to subsist through the winter, I shut up the hive, and gave them half a pint of honey every day. They immediately set to work, filled the empty cells, and then constructed new cells enough to fill another box, in which they deposited the remainder of the honey.

A more interesting proof is thus related by the same gentleman. In the summer of 1824, I traced some wild bees which had been feeding on the flowers in my meadow, to their home in the woods, and which I found in the body of an oak tree exactly fifty feet from the ground. Having caused the entrance of the hive to be closed by an expert climber, the limbs were separated in detail, until the trunk alone was left standing. To the upper extremity of this, a tackle-fall was attached, so as to connect it with an adjacent tree, and a saw being applied below the naked trunk, was cut through. When the immense weight was lowered nearly to the earth, the ropes broke, and the mass fell with a violent crash. The part of the

tree which contained the hive, separated by the saw, was conveyed to my garden, and placed in a vertical position. On being released, the bees issued out by thousands, and though alarmed, soon became reconciled to the change of situation. By removing a part of the top of the block, the interior of the hive was exposed to view, and the comb itself, nearly six feet in height, was observed to have fallen down two feet below the roof of the cavity. To repair the damage was the first object of the laborers, in doing which, a large part of their store of honey was expended, because it was too late in the season to obtain materials from abroad. In the following February these industrious, but unfortunate insects, issuing in a confused manner from the hive, fell dead in thousands around its entrance, the victims of a poverty created by their efforts to repair the ruins of their habitation.

Of the Propolis. This is a brown, odoriferous, resinous substance, more tenacious than wax, and well adapted for cementing and varnishing. It is used by the bees to stop all crevices, to exclude insects, air and light; and employ it as a tenacious cement, to attach their comb to the top of the hive.

Mouffet, in his *Insectarum Theatrum*, quotes Cordus for the opinion, that propolis is collected from the buds of trees, such as the poplar and birch; and Reim says it is collected from pine and fir. Huber, among his ingenious experiments and observations, ascertained that their assertions were correct.

For many years, says he, I had fruitlessly endeavored to find them on trees producing an analagous substance, though multitudes had been seen returning laden with it.

In July, some branches of the wild poplar, which had been cut since spring, with very large buds, full of a reddish, viscous, odoriferous matter, were brought to me, and I planted them in vessels before hives, in the way of the bees going out to forage, so that they could not be insensible of their presence. Within a quarter of an hour they were visited by a bee, which separating the sheath of a bud with its teeth, drew out threads of the viscous substance, and lodged a pellet of it in one of the cavities of its legs; from another bud it collected another pellet for the opposite limb, and departed to the hive. A second bee took the place of the former in a few minutes, following the same procedure. Young shoots of poplar, recently cut, did not seem to attract these insects, as their viscous matter had less consistence than the former.

Different experiments proved the identity of this substance with propolis; and now, having only to discover how the bees applied it to use, we peopled a hive so prepared as to fulfil our

views. The bees, building upwards, soon reached the glass above; but unable to quit their habitation, on account of rain, they were three weeks without bringing home propolis. Their combs remained perfectly white until the beginning of July, when the state of the atmosphere became more favorable for our observations. Serene warm weather engaged them to forage, and they returned from the fields laden with a resinous gum, resembling a transparent jelly, and having the color and lustre of the garnet. It was easily distinguished from the farinaceous pellets then collected by other bees. The workers bearing the propolis ran over the clusters suspended from the roof of the hive, and rested on the rods supporting the combs, or sometimes stopped on the sides of their dwelling, in expectation of their coming to disencumber them of their burden. We actually saw two or three arrive, and carry the propolis from the limbs of each with their teeth. The upper part of the hive exhibited the most animated spectacle: thither a multitude of bees resorted from all quarters, to engage in the predominant occupation of the collection, distribution and application of the propolis. Some conveyed that of which they had uploaded the purveyors in their teeth, and deposited it in heaps; others hastened, before its hardening, to spread it out like a varnish, or formed it into strings, proportioned to the interstices of the sides of the hive to be filled up. Nothing could be more diversified than the operations carried on.

Of the Honey. This is the richest extract from the finest flowers. It is a vegetable secretion, which appears at different seasons of the year, especially when flowers in general are in bloom. The bees lick it with their long tongue and proboscis from the flowers; it is swallowed, and on their return to the hive is disgorged, not from the trunk but the mouth, into the cells. The best sort of honey is of a thick consistence, and of a whitish color, inclining to yellow; possessing an agreeable smell and a pleasant taste. That honey which is made from the flowers of the mignonette is of superior fragrance, and in great abundance; its flowers continue in bloom all the summer and autumn, affording both honey and farina the whole season. The comb first made by a new swarm, is of the purest and most delicate white, and the honey which it contains, is of the purest kind, light-colored, and of delicious flavor, and is called *virgin honey*. Honey is the source of wax, and the food of bees; its secretion from flowers is effected by adventitious circumstances, and its qualities are different in different countries. Being a vegetable production, the properties of honey depend entirely on the nature of the plants

from which it is collected. Bees collect some part of their honey from what is commonly called *honey dew*. This is an exudation found on the leaves of trees in very hot sultry weather. While one kind of honey is of the finest flavor, delicious to the taste, pure and transparent, another is of an entirely different consistence, dark, greenish, tenacious and bitter; and a third kind has been known to produce deleterious effects, which were almost, if not quite, fatal to human life. The late Dr. Barton, of Philadelphia, some years ago published an account of poisonous honey, supposed to be produced by poisonous plants, as *kalmia augustifolia*, or dwarf laurel; *kalmia latifolia*, or great laurel. Other plants, in the opinion of Dr. Barton, produce unwholesome honey, such as Pennsylvania mountain laurel, and the *Datura Stramonium* or Jamestown weed. These plants ought to be extirpated from the vicinity of bee establishments.

As an article of food, honey, when immediately used, is pernicious to weak stomachs, in which it readily ferments, and occasions flatulency. It possesses, however, salubrious properties; as a medicine, it is a very useful aperient and expectorant, especially when it has been boiled, in which state it may be used with safety and advantage, by asthmatic patients, to promote expectoration of tough phlegm.

Of the Bee Bread. During the summer, and till late in autumn, bees bring home in the hollow of their legs a substance of a yellow, reddish or pale color, in considerable quantities. This is the farina, or pollen, obtained from various sorts of flowers of plants. This is commonly called *bee bread*, and was formerly supposed to be wax. But it is now known that no elementary principles of wax reside in pollen, it is collected solely for the purpose of feeding the young brood, and the perfect bees never live upon it, but the workers take it grain by grain in their teeth, and transmit it to the mouths of the larvæ.

Of the Construction and Architecture of the Combs. The most profound philosopher, equally with the most incurious of mortals, is struck with an astonishing air of grandeur on inspecting the internal arrangement of a bee-hive. He beholds a city in miniature. He sees this city divided into regular streets, these streets composed of houses constructed on the most exact geometrical principles and the most symmetrical plan; some serving for store-houses for food, others for the habitations of the citizens, and a few, much more extensive than the rest, destined for the palaces of a sovereign. He perceives that the substance of which the whole city is

built, is one which man, with all his skill, is unable to fabricate; and that the edifices in which it is employed are such as the most ingenious artist would find himself incompetent to erect. And the whole is the work of a society of insects! He exlcaims with Bonnet,

> '*Quel abîme aux yeux du sage qu'une ruche d'Abeilles!*
> *Quelle sagesse profonde se cache dans cet abîme!*
> *Quel philosophe osera le fonder!*' *

Nor have its mysteries yet been fathomed. Philosophers have in all ages devoted their lives to the subject; from Aristomachus of Soles in Cilicia, who we are told by Pliny, for fifty-eight years attended solely to bees, and Philiscus, the Thracian, who spent his whole lifetime in the forests investigating their manners, to Swammerdam, Reaumur, Hunter, and Huber of modern times. Still the construction of a bee-hive is a miracle which overwhelms our faculties.

The hives with which they are provided are not essential to their labors, for they can equally form their city in the hollow of a tree, or any other cavity. In whatever age, country, or situation it has existed, the general plan which they follow has been the same.

> 'While heaven born instinct bounds their measured view,
> From age to age, from Zembla to Peru,
> Their snow-white cells the ordered artists frame,
> In size, in form, in symmetry, the same.'

Those who have seen a honey-comb, must have observed that it is a flattish cake composed of a vast number of cells, for the most part hexagonal, (See Fig. 2.) regularly applied to each other's sides, and arranged in two strata or layers placed end to end. The interior of a bee-hive consists of several of these combs fixed to its upper part and sides, arranged vertically at a small distance from each other, so that the cells composing them are placed in a horizontal position, and have their openings in opposite directions. The distance of the combs from each other is about half an inch, that is, sufficient to allow two bees busied upon the opposite cells to pass each other with facility. Besides these vacancies, which form the main streets of their community, the combs are promiscuously

* What an abyss to the eyes of the wise is that of a bee-hive!
What depth of wisdom is concealed in it!
Where is the philosopher that will dare to explain it!

pierced with holes which serve as posterns for easy communication from one to the other without losing time to go round.

The arrangement of the combs is well adapted for its purpose, but it is the construction of the cells which is most admirable and astonishing. As these are formed of wax, which is of no great abundance, it is important that as little as possible of such a precious material should be consumed. Bees, therefore, in the formation of their cells, have to solve a problem which would puzzle some geometricians, namely:

A quantity of wax being given, to form of it similar and equal cells of a determinate capacity, but of the largest size in proportion to the quantity of matter employed, and disposed in such a manner as to occupy in the hive the least possible space.

Every part of this problem is practically solved by bees. If their cells had been cylindrical, which form seems best adapted to the shape of a bee, they could not have been applied to each other without leaving numberless superfluous vacuities. If the cells were made square or triangular, this last objection, indeed, would be removed; but besides that a greater quantity of wax would have been required, the shape would have been inconvenient to a cylindrical-bodied animal. All these difficulties are obviated by the adoption of hexagonal cells, which are admirably fitted to the form of the insect, at the same time that their sides apply to each other without the smallest vacant intervals. Another important saving in materials is gained by making a common base serve for two strata of cells. Much more wax as well as room would have been required, had the combs consisted of a single stratum only. But this is not all. The base of each cell is not an exact plane, but is usually composed of three pieces in the shape of the diamonds on playing cards, and placed in such a manner as to form a hollow pyramid. This structure, it may be observed, imparts a greater degree of strength, and still keeping the solution of the problem in view, gives the greatest capacity with the smallest expenditure of material. This has actually, indeed, been ascertained by mathematical measurement and calculation. Maraldi, the inventor of glass hives, determined, by minutely measuring these angles, that the greater were 109° 28′, and the smaller 70° 32′; and M. Reaumur, being desirous to know why these particular angles are selected, requested M. Kœnig, a skilful mathematician, without informing him of his design, or telling him of Maraldi's researches, to determine, by calculation, what ought to be the angle of a six-sided cell, with a concave pyramidal base, formed of three similar and

equal rhomboid plates, so that the least possible matter should enter into its construction. By employing what geometricians denominate the *infinitesimal calculus*, M. Kœnig found that the angles should be 109° 26′ for the greater, and 70° 34′ for the smaller, or about two-sixtieths of a degree, more or less, than the actual angles made choice of by bees. The equality of inclination in the angles has also been said to facilitate the construction of the cells.

What a surprising agreement between the solution of the problem and actual measure!

Besides the saving of wax effected by the form of the cells, the bees adopt another economical plan suited to the same end. They compose the bottoms and sides of wax of very great tenuity, not thicker than a sheet of writing paper. But as walls of this thickness at the entrance would be perpetually injured by the ingress and egress of the workers, they prudently make the margin at the opening of each cell three or four times thicker than the walls. Dr. Barclay says, that the sides and bottom of each cell are actually double, or, in other words, that each cell is a distinct, separate, and in some measure an independent structure agglutinated only to the neighboring cells, and that when the agglutinating substance is destroyed, each cell may be entirely separated from the rest.

(*To be continued.*)

THE SILK WORM.

Grand Division—*Articulata*, having jointed trunks and limbs. Class—*Insecta*, comprising insects. Order—*Lepidoptera*, having scaly wings. Genus—*Bombyx*, comprising silk worms. Species—*Mori*, subsisting on mulberry leaves.

—

Nature ‘set to work millions of spinning worms,
That in their green shops weave the smooth haired silk
To deck her sons.’

—

The silk worm is one of the most interesting of the insect race. It has long attracted the attention of the lovers of nature; and on account of the usefulness and importance of its produce in manufactures and commerce, its wonderful display of instinct and economy, and the singularity of its transformations, its history eminently deserves our attention, and ought to be more generally known and studied.

The eggs which produce the silk worm, if perfect, are of an ash colored gray, with a slight tinge of purple, and so much resembling the seeds of the poppy, that they have been sold as silk worms' eggs. They are hatched in the spring, usually about the month of May or June. Being exposed six or seven days to a gradual temperature from 77 to 93° F. the young worms or larvæ are brought forth, which are at first in size proportioned to the eggs from which they are produced. At their birth, they are of various hues, which are probably caused by the different degrees of heat applied to the hatching process. The predominating complexions are the ruddy, the black and the ash colored.

As soon as the worms come out of their shells, they seek and cling to mulberry leaves. These they immediately commence eating, and continue to eat voraciously during their growth, giving themselves but few intervals of repose. It is estimated that they devour sixty thousand times their weight at birth.

The silk worm changes its skin, popularly called *moulting*, four times during its growth. The intervals at which the four moultings follow each other, depend much on climate or temperature, as well as on the quantity of food. It is thence found, that if they are exposed to a high temperature, say from 81 to 100° F. the moultings will be hastened; and only five days will be consumed in moulting the third or fourth time, while those worms that have not been hastened take seven or eight days.

The period of the moultings is also influenced by the temperature in which the eggs have been kept during winter. When the heat of the apartment has been regulated, the first moulting takes place on the fourth or fifth day after hatching. The worms become glossy, lose their appetite, contract in size, and hide themselves in a state of lethargy, under the remains of the leaves. At this diseased state the mouth is more slender, the whole body is languid, and they refuse to take any nourishment. This critical period which was preceded by a voracious appetite for several days, is wisely ordered for the purpose of distending the first skin, which now becomes flaccid and dry. The worms extricate themselves from this useless covering, which would otherwise have proved fatal to them. They are very diligent in their endeavors to quit it. The head is the first part disengaged; and this dry skin glides progressively to the other extremity of the body, and the little animal comes forth in a new garment. The body is longer, brighter, and less marked with different

gradations of color. The snout is larger, and not so black as it was before the change. The state of torper of these worms presents always the same appearances. The second moulting takes place on the eighth day after hatching, the third takes up the thirteenth and fourteenth days, and the last occurs on the twenty-second and twenty-third days. The fifth age, in such cases, lasts ten days, at the end of which, or thirty-two days after hatching, the silk worm attains its full growth, and ought to be three inches long; (See Fig. 4.) but if the worms have not been properly managed they will not be so long.

They are provided by nature with twelve eyes; six on each side of the head, four of which are in the upper range, and two in the lower. The crystalline humor of these eyes is so thin that strong rays of light make a violent impression upon them. When they are struck by dazzling vibrations of light, it sets the worms almost into convulsions.

The body consists of twelve rings, nine of which are furnished on each side with *stigmata*, or breathing holes. These eighteen stigmata communicate with two air vessels running parellel the whole length of the body; and perform the office of lungs. They have sixteen feet under the rings, eight on each side; each foot has a considerable number of hooks, or claws, of which Malpighi counted forty; and those of the first six are curved to enable the insect to cling to objects. The mouth has two parallel jaws, with teeth which move horizontally. They have along the back, beneath the stomach, two spirally-convolved tubes, about a foot in length, which are filled with a silky gum, which they spin into very fine threads, by means of a tube behind the mouth, which terminates in a small papilla. When this fluid is exposed to the air it dries and becomes a thread of silk.

After two days of convalescence on entering their fifth age, the silk worms pass eight or ten days more in satisfying a voracious appetite, in rapidly increasing their size, and in filling themselves with silky matter. They soon afterwards diminish in bulk, become transparent, of a lighter color, and show some agitation. They crawl about continually, raise the head, and seek for some twig or branch placed for the purpose, and commence spinning silk. In this operation they proceed with the greatest caution, looking carefully for a spot in which they may be most secure from interruption.

We usually, says the Abbé de la Pluche, give it some little stalks of broom, heath, or a piece of paper rolled up, into which it retires, and begins to move its head to different pla-

ces, in order to fasten its thread on every side. All this work, though it looks to a bystander like confusion, is not without design. The silk worm neither arranges its threads nor disposes one over another, but contents itself with distending a sort of cotton or floss to keep off the rain; for Nature having ordained silk worms to work under trees, they never change their method, even when they are reared in our houses.

When my curiosity led me to know how they spun and placed their beautiful silk, I took one of them and frequently removed the floss with which it first attempted to make itself a covering; and as by this means I weakened it exceedingly, when it at last became tired of beginning anew, it fastened its threads on the first thing it encountered, and began to spin very regularly in my presence, bending its head up and down, and crossing to every side. It soon confined its movements to a very contracted space, and, by degrees, entirely surrounded itself with silk; and the remainder of its operations became invisible, though these may be understood from examining the work after it is finished. In order to complete the structure, it must draw out of the gum-bag a more delicate silk, and then with a stronger gum bind all the inner threads over one another.

Here, then, are three coverings entirely different, which afford a succession of shelter. The outer loose silk, or floss, is for keeping off the rain; the fine silk in the middle prevents the wind from causing injury; and the glued silk, which composes the tapestry of the chamber where the insect lodges, repels both air and water, and prevents the intrusion of cold.

The silk worm employs ordinarily three or four days in making its cocoon. On the first day it makes its web; on the second it forms its ball and almost covers itself with silk, the third day it is quite hid, and on the following days it employs itself in thickening and strengthening its ball. After building its cocoon, it divests itself of the fourth skin and is transformed into a chrysalis, where it remains fifteen days, and then, without saw or centre-bit, makes its way through the shell, silk, and the floss, and makes its appearance in the form of a white moth; for the same Being who teaches it how to build itself a place of rest, where the delicate limbs of the moth may be formed without interruption, instructs it likewise how to open a passage for escape.

'When vernal sunbeams pierce their dark retreat,
The heaving tomb distends with vital heat;
The full formed brood impatient of the cell,
Start from their trance and burst their silken shell;
Trembling, awhile they stand, and scarcely dare

To launch at once upon the untried air:
At length assured, they catch the favoring gale,
And leave their sordid spoils and high in ether sail.'

The cocoon is like a pigeon's egg, (See Fig. 5.) and more pointed at one end than the other; and it is remarkable that the silk worm does not interweave its silk towards the pointed end, nor apply its glue there as it does in every other part,* by bending itself all around with great pliantness and agility; what is more, it never fails, when its labor is finished, to fix its head opposite to the pointed extremity. The reason of its taking this position is, that it has purposely left this less strongly cemented, and less exactly closed. It is instinctively conscious that this is to be the passage for the perfect insect which it carries in its bowels, and has therefore the additional precaution never to place this pointed extremity against any substance that might obstruct the moth at the period of its egress.

When the silk worm has exhausted itself to furnish the labor and materials of the three coverings, it loses the form of a worm, its spoils drop all around the chrysalis; first throwing off its skin, with the head and jaws attached to it, and the new skin hardening into a sort of leathery consistence. Its nourishment is already in its stomach, and consists of a yellowish mucus, but gradually the rudiments of the moth unfold themselves—the wings, the antennæ, and the legs becoming solid. In about a fortnight or three weeks, a slight swelling in the chrysalis may be remarked, which at length produces a rupture in the membrane that covers it, and by repeated efforts the moth burst through the leathery envelope into the chamber of the cocoon.

The moth then extends its antennæ, together with its head and feet, towards the point of the cone, which not being thickly closed up in that part gradually yields to its efforts; it enlarges the opening, and at last comes forth, leaving at the bottom of the cone the ruins of its former state—namely the head and entire skin of the caterpillar, which bear some resemblance to a heap of foul linen.

Reaumur was of opinion that the moth makes use of its eyes as a file, in order to effect its passage through the silk; while Malpighi, Peck, and others, believe that it is assisted by an acid which it discharges in order to dissolve the gum that holds the fibres of the silk together. Mr. Swayne denies that the threads are broken at all, either by filing or solution; for he succeeded in unwinding a whole cocoon from which the

* This is denied by recent observers.

moth had escaped. The soiling of the cocoon by a fluid, however, we may remark, is no proof of the acid; for all moths and butterflies discharge a fluid when they assume wings, whether they be inclosed in a cocoon or not; but it gives no little plausibility to the opinion, that the end of the cocoon is observed to be wetted for an hour, and sometimes several hours, before the moth makes its way out.

The moth (*Bombyx mori*) is of a delicate, white color, (See Fig. 6.) having four membranous wings, covered with small scales resembling dust; six legs and two antennæ. One of the most remarkable features in the organization of this wonderful insect, is the organs of vision. It has two eyes now, instead of twelve, though immovable, which embrace, by a peculiar constructure, all surrounding objects, and as Reaumur conjectures, serve also as a file to cut the threads of the cocoon, when the insect strives to escape from it. They are protuberant, and thin surfaces consisting of a multitude of hexagonal lenses, placed with the greatest regularity. When the eye is separated and made clear, these hexagons are as transparent as crystal. Leuwenhoek having properly prepared and fitted an eye to a microscope, he could see through it clearly; but the largest objects viewed were diminished to an incredible small size. The steeple of the church in Delft, which is three hundred feet high, appeared at the distance of seven hundred and fifty feet, no larger than the point of a needle by the naked eye.

The moths come forth generally about the last of June, from sunrise to eight or nine o'clock in the morning. The resuscitation continues during ten days. The males generally precede the females, and appear in much greater numbers on the first and second days. The females will show themselves on the third and fourth days in such multitudes as to produce nearly an equality in the two sexes. The males are slender, brisk, and always in motion; the females are more bulky, much heavier, and more quiet. They seemed produced for no other purpose than to transmit a future brood. The male dies immediately after pairing with the female, which takes place six or eight days after he makes his appearance from the cocoon. The female lays about 400 eggs, and in three or four days expires.*

* There may be seen two of these moths, male and female, in the New England Museum, Spec. 105. The extent of the male's wings, is about five inches; its length, including the head and abdomen, about two inches. The extent of the female's wings is about six inches; its length about equal to that of the male.

A question here naturally presents itself—Why are these insects subject to such remarkable changes? For what end is it that, instead of preserving, like other animals, the same general form from infancy to old age, they appear at one period under a shape so different from that which they finally assume; and why should they pass through an intermediate state of torpidity so extraordinary? We can only answer that such is the will of the Creator, who doubtless had the wisest ends in view, although we are incompetent satisfactorily to discover them.

It is the middle portion of the cocoon, after removing the floss or loose silk on the exterior, which is used in our manufactures; and the first preparation is to throw the cocoons into warm water, and stir them about with twigs, to dissolve any slight gummy adhesions which may have occurred when the silk worm was spinning. The threads of several cocoons, according to the strength of the silk wanted, are then taken and wound off upon a reel. The refuse, consisting of what we may call the tops and bottoms of the cocoons, are not wound, but carded, like wool or cotton, in order to form coarser fabricks. We learn from the fact of the cocoons being generally unwound without breaking the thread, that the insect spins the whole without interruption. It is popularly supposed, however, that if it be disturbed during the operation by any sort of noise, it will take alarm, and break its thread; but Latreille says this is a vulgar error.

The length of the unbroken thread in a cocoon varies from six hundred to fifteen hundred feet; and as it is all spun double by the insect, it will amount to about three thousand feet of silk, the whole of which does not weigh above four grains and a half: five pounds of silk from six thousand cocoons is about the usual average. When we consider, therefore, the enormous quantity of silk which is used at present, the number of worms employed in producing it will almost exceed our comprehension. The manufacture of the silk, indeed, gives employment, and furnishes subsistence to several millions of human beings; and we may venture to say, that there is scarcely an individual in the civilized world who has not some article made of silk in his possession.

Think, says Bonnet, but of the cocoon of the silk worm. How many hands, how many machines does this little ball set in motion! Of what riches should we not have been deprived if the moth of the silk worm had been born a moth, without having been previously a caterpillar! The domestic econo-

my of a large portion of mankind would have been formed on a plan altogether different from that which now prevails.

The account of silk worms may be traced back to time immemorial. The Seres are mentioned in the oldest Sanscript books, as a gentle race who shunned mankind, whose occupation was to attend silk worms. It seems to have been in Asia that silk was first known; and it was from thence that the ancients obtained it, calling it, from the name of the country whence it was supposed to be brought, Serica, a part of the Chinese Empire. Of its origin they were in a great measure ignorant. Some supposing it to be grown on trees as hair grows on animals—others, that it was produced by a shell-fish similar to the muscle, which is known to throw out threads for the purpose of attaching itself to rocks—others, that it was the entrails of a sort of spider, which was fed for four years with paste, and then with the leaves of the green-willow, till it burst with fat—and others, that it was the produce of a worm which built nests of clay and collected wax. Aristotle, with more truth, that it was unwound from the pupa of a large horned caterpillar. It is probable, says the author of the Silk Manual, that the Romans first became acquainted with the real nature of silks from the writings of Dionysius Perioyetes, the geographer, who had been sent by Augustus to compile an account of the oriental regions, and who informed his countrymen that precious garments were manufactured by the Seres from threads finer than those of the spider. Among all the articles of elegance belonging to the luxurious Cleopatra, none seemed more to excite their admiration and astonishment than the silken sails of her pleasure barge, in which she visited them at Alexandria. It was valued by them at its weight in gold; and the Emperor Aurelian refused his empress a robe of silk on account of its dearness. For a long time after, it continued to be so scarce and dear, that in the Roman dominions it was confined to women of fortune. It was moreover deemed so effeminate an article as to be unfit for the dress of men; and in the reign of Tiberius, a law was passed, that no man should dishonor himself by wearing silken garments. Two hundred years subsequent to this date, the use of it constituted one of the many opprobrious charges which were made against the character of the emperor Elagabulus. But modern degeneracy has departed from the severity of the ancient Romans. It is estimated that one half of mankind now make it an indispensable article of dress.

The empress of China keeps a feast in honor of silk worms, similar to the emperor's feast of agriculture; on which day she goes into the forest near the palace, and, with much pomp and ceremony, gathers with her own imperial hands, three branches of the mulberry tree. The care of the young worms is confided to an intelligent woman, who is called *Tsammon*, or the mother of silk worms. She is particular to have on very clean clothes, and not to touch wild endive, the smell of which is injurious to silk worms; and she must wear a very thin dress in order to judge of the suitable degree of warmth in the room, for the Chinese use no thermometer.

The history of China mentions that seven hundred years before Abraham, a new epoch commenced in the culture of silk. The silk insect began to be sheltered and carefully tended, instead of being left in its natural state on the branches of mulberry trees untouched, in a neglected and unprofitable state.

The empress Si-ling-chi gathered the worms from the trees, and with the women attached to her household, endeavored to attend them with much care in the imperial apartments, to supply them with mulberry leaves, and keep them very clean. It was soon found that they thrived much better in rooms than in the open air, where they were constantly exposed to their natural enemies, serpents, spiders, &c. and to the ill effects of changes of temperature. The cocoons gathered in rooms were more numerous, larger and of better quality, than those gathered in the open air. Care was afterwards taken to hatch the eggs in rooms. The superiority of this artificial mode of culture soon became more and more manifest. This mode of culture was followed by the successive sovereigns of the empire, and silk became extensively cultivated throughout the empire, and all the rich and affluent were dressed in satin or damask. Subsequently it became an article of exportation, and a source of great wealth. The traders of Serica first carried the silken stuffs over the whole breadth of Asia. Among the most active traders of that epoch were the Phœnicians. The culture spread from China to India and Persia, and it was for many centuries, and is even at the present day a source of wealth to those countries.

Silk worms were introduced into Constantinople from the East Indies, in the year 555, by two monks. For ages the secret was confined to China and India; until two Persian monks, travelling in those countries, acquired the mystery, and imparted it to the emperor Justinian. Great was his astonishment to learn that it was produced by a species of

worm, and that the monks had purloined and brought off a quantity of eggs in the hollow of a cane, by means of which they might be propagated in his dominions. The monks were munificently rewarded. Manufactures were established, and the luxurious Romans were no longer indebted to their enemies for their costly clothing.

From this beginning, with judicious management the art of raising silk soon spread. The first manufactures were established at Constantinople, at Athens, at Thebes, and at Corinth. In the year 1130, Roger, King of Sicily, brought manufacturers of silk from Greece, and settled them at Palermo, where they taught the Sicilians the art of cultivating the silk worm, and of spinning and weaving silk. From Sicily, the art extended over all Italy, and from thence to Spain. It was not cultivated in France until the time of Henry IV. who, considering that mulberries would grow in his kingdom as well as in Italy, resolved, in opposition to the opinion of Sully, to attempt introducing it, and fully succeeded. In 1286, the ladies of some noblemen first appeared in silk mantles at a splendid ball in England.

It was not cultivated to much extent in England till the time of James I. While he was king of Scotland, he was forced to beg of the earl of Mar the loan of a pair of silk stockings, to appear in before the English ambassador, enforcing his request with the cogent appeal, '*For ye would not, sure, that your king should appear as a scrub before strangers*'—a circumstance which probably led him to promote the cultivation of silk in England.

In America, the culture of the silk worm was introduced into Virginia in 1623, by James I., who himself composed a book of instructions on the subject, and caused mulberry trees, and silk worms' eggs to be sent to the colony. He made great efforts in order to have it take the place of tobacco in agricultural pursuits. Thirty years afterwards it was enacted that every planter, who should not have raised at least ten mulberry trees for every hundred acres of land in his possession, should be fined ten pounds of tobacco. Five thousand pounds of tobacco were promised to any one who should produce one thousand pounds of wound silk in one year. In 1664, Mr. Walker, a member of the legislature, stated that he had seventy thousand mulberry trees on his estate. In 1666 all statutory provisions were repealed, because the business was in so thriving a condition as no longer to require protection. The business was soon after suffered to decline; although the white mulberry abounds at present in the eastern part of

that state. The decline of the silk business in that state was probably owing to new emigrants, who brought with them new views and habits. As they brought their slaves, it became necessary that an immediate annual profit should be realized. Hence the culture of rice and indigo was introduced, and on account of the immediate profit derived from their culture, that of silk languished, which would have required a steady perseverance for a course of years.

The culture of silk was introduced into Georgia at the earliest period of its settlement. The trustees of the colony transmitted mulberry trees as well as seeds and silk worms' eggs. The public seal of the colony represented silk worms in their various stages; and had for its inscription '*Non sibi sed aliis.*' In the year 1736, a quantity of raw silk was raised in that colony, and was manufactured at Derby by Sir Thomas Lombe into a piece of stuff, and presented to the queen. During about thirty years, owing probably to the want of capital, the undertaking languished; a few years, however, before the revolution, considerable quantities of raw silk began to be exported to England, which was found equal to the best silk of Piedmont, and to be worked with less waste than the China silk. In 1766 more than twenty thousand pounds of raw silk were imported into England from Georgia.

In the year 1769, on the recommendation of Dr. Franklin, through the American Philosophical Society, a filature of raw silk was established at Philadelphia, by private subscriptions, and under the direction of a Frenchman who was said to be skilled in the art; but no result of any consequence appears to have followed from that undertaking. The revolution came and put an end to these promising exertions. There is little doubt to be entertained that if the United States had continued to remain British colonies, the culture of silk would have made an immense progress in this country, because its promotion was a matter of vital interest to the mother country, whose manufactures would have been furnished from hence with the raw material, which they are obliged to purchase at a great expense, drawing very little from their dominions in Bengal, where it seems it is imperfectly prepared.

In South Carolina the ladies attended to this culture. Mrs. Pinckney took with her to England, a quantity of silk sufficient to make three complete dresses, one of which she presented to the princess dowager of Wales, one to Lord Chesterfield, the third was in possession of her daughter, Mrs. Hory of Charleston, as late as 1809.

(To be continued.)

GOLD.

Class—*Metallic*, comprising metals. **Genus**—*Aurum*, comprising gold.

'The mine a thousand treasures brings.'

Gold is never found mineralized, but mostly in a metallic state, though generally alloyed with silver, copper, iron, or all three. It is found either in separate lumps, or visible grains, among the sands of rivers, and in primitive rocks.

Gold is found in most parts of Europe, but no where in large quantities. The sands of the Danube, the Rhine, the Rhone, the Garonne, the Tagus, and many other rivers, contain small quantities. The chief mines of importance are at Kremnitz, in Austria, which produce more than all the rest of Europe. Mines have recently been discovered in the Ural Mountains.

Africa furnishes large quantities of gold, which are washed down by the rivers. It is especially abundant on the Niger, in Western Africa, and on the coast of Zanguebar; and forms an important article of commerce. Japan also, and the East India Islands, particularly Sumatra, Borneo and Celebez, produce gold for commerce.

But Mexico and South America produce gold in far greater abundance than any other countries on the globe. The whole amount is eleven millions of dollars annually. A single mine furnishes more than all Europe. It is found at the foot of the Andes, almost throughout their whole extent, sometimes embraced in veins of primary or secondary rocks. Brazil produces large quantities—chiefly from alluvial sands.

In the United States, gold has been found in North Carolina and Georgia, in great abundance. Large quantities have been sent from these places to the United States mint.

Gold is of a yellow color, and cannot be tarnished by oxydation, on exposure to water or the atmosphere. It is the heaviest of all metals except platina, being 19.3 times heavier than water. It is soft, very tough, ductile and malleable. Its tenacity is such that a wire of one tenth of an inch in diameter will support a weight of five hundred pounds without breaking, yet it possesses less tenacity than iron, copper, platina, or silver. It is ductile and malleable beyond any known limits. The method of extending it used by gold-beaters, consists in hammering a number of thin rolled plates between skins or animal membranes, upon blocks of marble fixed in wooden frames. A grain of gold has been extended to fifty-

six and three-fourth square inches of leaf, and an ounce, which, in the form of a cube, is not half an inch either high, broad, or long, is beaten under the hammer into a surface of one hundred and forty-six and a half square feet. There are gold leaves not thicker in some parts than the three hundred and sixty-thousandth part of an inch; but on the wire used by the lace-makers it is still thinner. An ingot of silver, usually about thirty pounds weight, is rounded into a cylinder, an inch and a half in diameter, and twenty-two inches long. Two ounces of gold leaf are sufficient to cover this cylinder, and sometimes it is effected with a little more than one. The ingot is repeatedly drawn through the holes of several irons, each smaller than the other, till it becomes finer than a hair; and yet the gold covers it, and never leaves the minutest part of the silver bare, even to the microscope. It has been calculated that it would take fourteen millions of films of gold, such as is on some fine gilt wire, to make up the thickness of one inch: whereas fourteen million leaves of common printing paper would occupy nearly three-fourths of a mile in thickness. It is said that a pound of gold may be hammered so very thin, as to furnish enough to gild a wire of sufficient length to surround the earth. It becomes fusible in a temperature of 2517° F. above zero. Its color, when melted, is of a bluish green; and the same color is exhibited by light transmitted through gold leaf.

Gold may be dissolved by nitro-muriatic, and by oxy-muriatic acids, and by no other acid.

Illustration. Put a little muriatic acid into a wine-glass, and twice as much nitric acid in another wine-glass. Drop into each a small piece of gold leaf, and neither of the pieces will be dissolved. Now pour the contents of one glass into the other, and both pieces of gold will be immediately dissolved.

Application. This mixture is the *aqua regia* of old authors. The new compound formed is muriate of gold; but it seems that gold requires the joint action of the two acids, the nitric acid affording oxygen for oxydating the gold, and then the muriatic acid unites with it.

If white satin riband, or silk, be moistened with a diluted solution of gold, and while moist, exposed to a current of hydrogen gas or sulphurous acid gas, the metal will immediately be reduced, and the silk become gilt with a regular coat of gold. The potters dissolve gold to be applied to the common kind of porcelain, and it is used in a state of solution for staining ivory and ornamental feathers. It gives a beautiful

purple red, which cannot be effaced; even marble may be stained with it. Mercury and gold form a compound called the amalgam of gold, which is much used in gilding.

Iron, silver and copper may be covered with a thin coat of gold, which is called gilding.

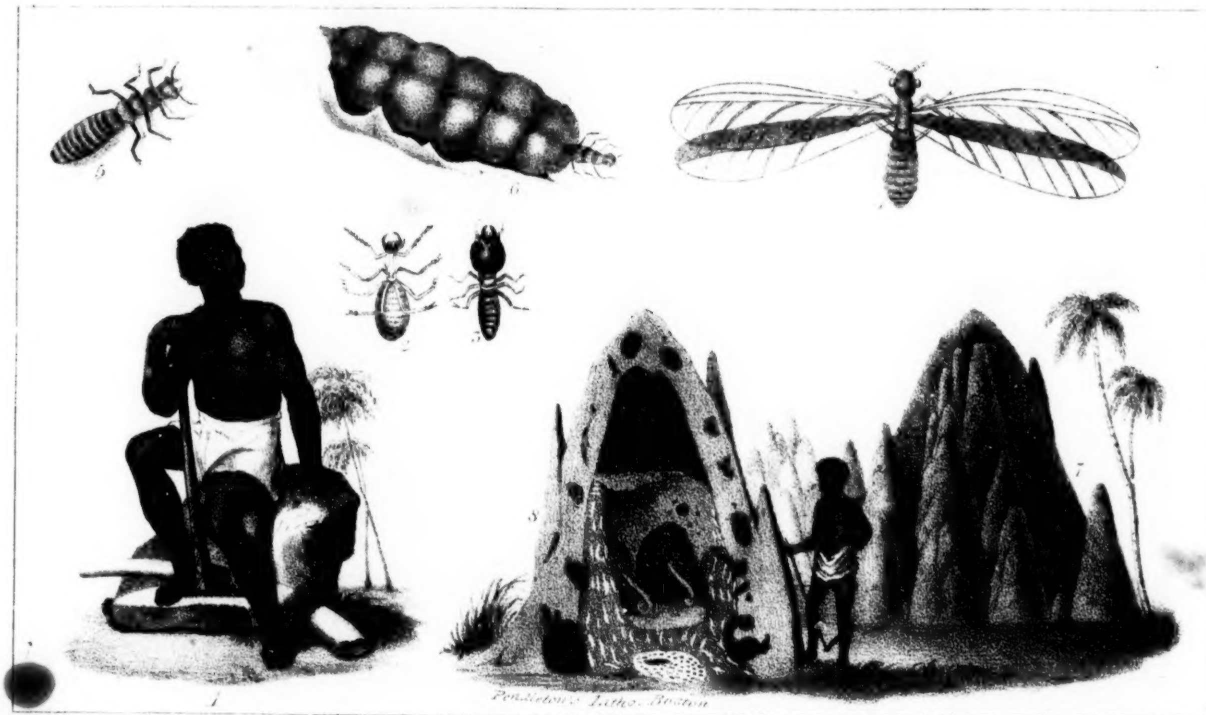
Illustration. Pour into a saturated solution of muriate of gold, that is, where there is no excess of acid, about twice as much sulphuric ether. Now brush upon a clean polished surface of iron or steel some of this liquid. The ether will soon evaporate and leave the gold covering the surface.

To gild silver or copper, heat gold and mercury together in a crucible, one part of gold to about eight of mercury, until they are completely alloyed; then throw the hot alloy into cold water. Having wet the silver or copper with diluted nitric acid, brush on the alloy with a fine brush (a wire brush is best) as uniformly as possible. Then drive off the mercury with heat, placing the gilded metal over hot coals. Afterwards the surface must be polished with a burnisher. The only objection made to this methed by artists is, that it is very difficult to lay on the alloy evenly. But experienced artists learn to brush over the bare spots while it is heating, being careful to avoid inhaling the mercurial fumes.

Application. This method of gilding iron is undoubtedly very perfect; but it is desirable that some better method for gilding the other metals should be devised. Most substances to be gilded may be conveniently covered with gold leaf.

Adulterations of gold coin may be detected, by taking the specific gravity.

Illustration. In order to take the specific gravity of a piece of gold coin, weigh the body first in air, then weigh it when it is plunged in water, and observe how much it looses of its weight in this fluid, and dividing the former weight by the loss sustained, the quotient is the specific gravity of the coin when compared with water. As, for example, it is usual to take a guinea, which weighs in air one hundred and twenty-nine grains, and when suspended by means of a fine hair, and immersed in water, it is found to balance one hundred and twenty-one grains and three-quarters, losing of its weight seven grains and a quarter; now one hundred and twenty-nine divided by seven and a quarter, gives about seventeen for the quotient; that is, the specific gravity of a guinea compared with that of water, is as about seventeen to one. If its specific gravity is 17.157, it is lawful coin. Standard gold coin is an alloy of one of copper to eleven of gold, in order to make the coin harder, that it may wear the better.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